Seasonal Measurement of Water Quality in River Amba, Nasarawa State, North Central, Nigeria

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Abstract: **This study is aimed at seasonal measurement of trace metals and physicochemical parameters of River Amba, Nasarawa State, North Central, Nigeria. The water data were collected during 2019 to 2020 from 3 sampling points distributed along the river. The physicochemical parameters analysed are pH, alkalinity, temperature, BOD, COD, conductivity and TDS. While, the trace metals in Mg/L are Pb, Cd, Zn, Mn, Fe and Cr. Trace metals during dry season ranges from 0.55 to 0.64, 0.41 to 0.45, 2.00 to 2.02, 0.20 to 0.22, 0.48 to 0.50 and 0.17 to 0.19 respectively. While during wet season, it ranges from 0.65 to 0.72, 0.55 to 0.65, 2.03 to 2.05, 0.22 to 0.25, 0.50 to 0.57 and 0.30 to 0.33 in that order. the result revealed that the mean concentrations of trace metals were above the permissive WHO/EU standards except for Mn and Zn in all the water samples irrespective of the season. Consequently, the physicochemical parameters analysed during wet and dry season are within the WHO recommended standard with exception of COD and BOD. The results indicate that seasonal change did not bring significant alteration in the parameters analyzed. In order to reduce the trace metals, laws should be enacted by the Governments to regulate the activities that take place in the river.**

Keywords: **Trace metals, physicochemical parameters, water quality, River Amba, seasonal measurement**

I. INTRODUCTION

The earth is covered by 70% of water and regrettably only 1% is a source of drinking. The main reasons for which water is domestically needed include drinking, bathing, cooking, and laundry [1]. However, rivers such as river Amba are not only used for domestic purposes but for recreation and irrigation, which is very important to man [2]. Heavy metals being a non-biodegradable and unrelenting environmental pollutant, may be dumped on the surface by human activities thus get the water polluted [3-4]. It is noteworthy to know that some of these heavy metals are important part of our diet, as trace elements while others are toxic [5]. Study revealed that Copper (Cu), Cobalt (Co), Manganese (Mn), Molybdenum (Mo), Selenium (Se) and Zinc (Zn) are good source of diet to both plants and animals while traces of Arsenic (As), Chromium (Cr), Nikel (Ni) and Tin (Sn) are essential for animals but not for plants [6]. Study also has it that toxic metals are also often added to the streams as salt (Sulfides, Phosphate and carbonates) [7]. They are very insoluble in hard water which often moves with sediment. The study further revealed that the transformation into readily accessible materials is a complex process and depends on many factors such as pH, sediment presence and hardness; the availability of these metals is determined by precipitation – dissolution reactions which are strongly affected by pH. Therefore at lower pH, heavy metals are more available and more reactive. Many of these metals then undergo methylation as a result of bioaccumulation where bacteria absorb these elements and change them from a metallic state into a toxic organo-metallic state. By becoming incorporated with an organic component; these metals become readily available and biological amplify in food chain [7]. Because these ecosystems provide water for domestic, drinking and irrigation purposes and also heavy metals contamination threatens agriculture and other food sources in the developing countries, physiochemical and heavy metals analysis in river calls for regular check [8-9]. Also, the water quality of river has been observed to vary seasonally in tandem with changes in temperature and rainfall [10–12]. In view of that low and high precipitation during dry and wet seasons in a tropical country like Nigeria can greatly change the water quality of the river. The high precipitation during the wet season can either decrease the pollutant concentration by dilution or deteriorate the water quality due to increased surface runoff from anthropogenic activities. Thus, the need for seasonal measurement of trace metals and physicochemical parameters in River Amba.

II. MATERIALS AND METHOD

Study Area

Amba River is located at Doma road in Lafia, Nasarawa State, North Central, Nigeria. On the both sides of the river are agricultural activities and human settlement. The river is been constantly used for washing cars, bathing and laundry, washing of household and domestic utensil. Also, it is a source of drinking water to the people living around the river.

Table 2.0 Sample Description

Sample	Sampling Point
A	50 Meters Before The Bridge
B	0 Meter At The Bridge
C	50 Meters Away From The Bridge

III. SAMPLING AND ANALYSIS

Samples were collected from the study area during the dry season of 2019 and rainy season of 2020 into labeled plastic containers that have been pre-cleaned with nitric acid, distilled water and finally rinse with the analysed sample water. The collected sample waters were transported to Chemistry Laboratory of Isa Mustafa Agwai 1 Polytechnic for analysis. The water samples were analysed for total dissolved solid (TDS), conductivity, alkalinity, total hardness, chemical oxygen demand (COD), and biological oxygen demand (BOD) according to standard methods described in APHA (1998). The pH and temperature of the water samples were measured and recorded at the site of collection using calibrated pH meter and thermometer respectively. The heavy metals analysis was measured using atomic absorption spectrophotometer (UNICAM 929). All analyses were done in triplicate and the mean and standard values were reported.

IV. RESULTS

Table 3.0 Levels of physicochemical parameters in the water samples and WHO standard

Dry season

Parameter	Sample A	Sample B	Sample C	WHO standard
`pH	5.94±0.02	6.04±0.04	6.01±0.01	6.5
COD(mg/L)	78±0.50	77.7±0.03	78.2±0.04	10
BOD(mg/L)	38.35±0.050	38.32±0.30	38.50±0.58	10
Temperature(^{0}c)	32±0.2	32±0.3	32±0.1	<40
Conductivity(S/M)	0.064±1.3	0.055±1.3	0.037±1.6	10
TDS(mg/L)	29.6±0.5	30.5±0.4	31.0±0.2	200
Alkalinity(mg/L)	6.21±1.10	7.06±2.50	7.04±1.50	200
T. Hardness(mg/L)	74.40±0.01	73.80±0.20	72.99±0.10	100

Field/Lab. Work, February 2019 and FEPA (1991) [13]

Wet season

Parameter	Sample A	Sample B	Sample C	WHO standard
`pH	6.0±0.02	6.40±0.05	6.11±0.06	6.5
COD(mg/L)	79.44±0.30	78.76±0.20	79.22±0.10	10
BOD(mg/L)	39.45±0.20	39.32±0.50	39.53±0.70	10
Temperature(^{0}c)	30±0.1	30±0.1	30±0.1	<40
Conductivity(S/M)	0.065±1.2	0.065±.1.2	0.045±1.4	10
TDS(mg/L)	27.6±0.8	28.06±0.9	29.50±0.10	200
Alkalinity(mg/L)	7.10±1.50	7.46±2.40	7.34±1.55	200
T. Hardness(mg/L)	72.54±0.01	73.88±0.20	71.99±0.10	100

Field/Lab work, February 2019 and FEPA (1991) [13]

Table 3.1 concentration of heavy metals in water sample in mg/L

Dry season

NA= Not available.

Trace metals	sample A	sample B	sample c	WHO standard	EU standard
Pb	0.55±0.02	0.64±0.01	0.56±0.02	0.01	0.01
Cd	0.41±0.25	0.45±0.22	0.43±0.23	0.005	0.005
Zn	2.00±0.26	2.02±0.28	2.01±0.27	3.00	NA
Mn	0.20±0.90	0.22±0.92	0.21±0.91	0.5	0.05
Fe	0.48±0.19	0.50±0.21	0.49±0.20	NA	0.2
Cr	0.17±0.04	0.19±0.07	0.18±0.05	0.05	0.05

Field/Lab. Work February 2019, FEPA (1991) [13] and European Union (1998) in Lenntech (1998-2009).

Wet season

Trace metals	sample A	Sample B	Sample C	WHO standard	EU standard
Pb	0.65±0.03	0.72±0.01	0.67±0.04	0.01	0.01
Cd	0.55±0.22	0.65±0.22	0.60±0.23	0.005	0.005
Zn	2.03±0.25	2.05±0.23	2.04±0.24	3.00	NA
Mn	0.22±0.70	0.25±0.50	0.23±0.60	0.5	0.05
Fe	0.50±0.20	0.57±0.19	0.56±0.18	NA	0.2
Cr	0.30±0.08	0.33±0.05	0.31±0.06	0.05	0.05

Field/Lab. Work September 2020, FEPA (1991) and European Union (1998) in Lenntech (1998-2009)

V. DISCUSSION

Table 3.0 presented the results of physicochemical parameters of both dry and wet seasons. It reveals that the pH value of dry season varied from 5.94 to 6.04 while that of wet season varied from 6.0 t0 6.40. The pH values showed a slight increased during the wet season. However, all the pH values reported are within the WHO recommended value for different uses such as irrigation, recreational and domestic [13]. The alkalinity variation mean value of the water also increased during wet season (7.10 to 7.46) but compared favourably with the dry season mean values (6.21 to 7.06). The seasonal variation of the alkalinity values of both analysed samples are within the suitability values, recommended by WHO [13]. The pH value evaluates the acidity/alkalinity of a solution is a function of dissolved materials. Thus, determines the suitability of water for diverse use. In contrast, the temperature value shows an increase during dry season than the wet season. This is in agreement with the study done by Aremu, (2017) [14]. Consequently, the BOD, COD, TDS and total hardness measurements show higher values increase during wet season than dry. It is in agreement with high level of conductivity during wet season than during dry season, see table 3.0. This is because conductivity is refers to its current carrying capacity and directly related to the concentration of ionized salt in water. That is, High level of conductivity is an indicative of high level of ionic substances such as manganese and iron which are present in industrial contaminant. The industrial contaminants may be due to textile effluent (Kabir *et al.*, 2002) [15]. The BOD and COD are also used to determining the contamination of surface water [14]. The mean values obtained, vividly show that they are within WHO recommended standards. Hardness is a parameter of water which stops lather formation with soap. This is due to precipitation of insoluble calcium and magnesium salts. The mean hardness values in the current study areas during both dry and wet are within the prescribed limit of 100 mg/L by WHO. Also, the TDS and the temperature values of both seasons are within the permissive limit of WHO standard, see table 3.0.

Table 3.1 presented the level of trace elements analysed for both the dry and wet seasons. It shows that the concentration mean values (mg/L) of Pb, Cd, Zn, Mn, Fe and Cr during dry season ranges from 0.55 to 0.64, 0.41 to 0.45, 2.00 to 2.02, 0.20 to 0.22, 0.48 to 0.50 and 0.17 to 0.19 respectively. While during wet season, it ranges from 0.65 to 0.72, 0.55 to 0.65, 2.03 to 2.05, 0.22 to 0.25, 0.50 to 0.57 and 0.30 to 0.33 in that order. From the result obtained, the level of trace metals during wet season is slightly higher than that of dry season. This may be due to surface run-off and erosion which move wastes having various trace metals into the water source during the wet season. It is interested to note that the concentration levels of Pb, Cd, Fe and Cr during wet and dry season are higher than the WHO/EU permissible standards. In contrast, the concentration levels of Mn and Zn of both seasons were found slightly below the permissible level of WHO/EU standards. This is in an agreement with other studies [14-17]. High concentration of trace metals is as a result of human activities and urbanization. For example, high level in the river could be attributed to the spread of lead from vehicular emission and the washing lubricating oil and grease from vehicle part into the river [18]. Consequently, the result of high concentration of Pb, Cd, Fe and Cr is an indication that the river is polluted. Thus, poses a serious threat to human and aquatic animals. However, despite common use of zinc for paints, electroplating in dyes and tires, the values obtained for zinc are not up to the recommended WHO threshold limit value of 3mg/L as such human and aquatic organisms are not at risk of Zn and Mn pollution at the time of analysis.

VI. CONCLUSION

The present study is based in measuring the seasonal variation of trace metals concentration and physicochemical parameters of River Amba in Nasarawa state. The result revealed trace metals (Pb, Cd, Zn, Mn, Fe and Cr) various level of concentration in the water sample. While the physicochemical parameters (PH, Temperature, T. hardness, Alkalinity, BOD, COD and Conductivity) at different levels of the water sample. The result of trace metals and physicochemical parameters shows high concentration during wet season than dry season. Consequently, the result of Pb, Cd, Fe and Cr are above the permissive WHO/EU standards. To decrease contamination of River Amba, suitable steps should be taken immediately.

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